INDOOR AIR QUALITY ASSESSMENT

Department of Revenue
67 Millbrook Street
Worcester, MA

Prepared by:
Massachusetts Department of Public Health
Bureau of Environmental Health
Indoor Air Quality Program
December 2016

Background

Building:	Department of Revenue (DOR)
Address:	67 Millbrook Street, Worcester, MA
Assessment Requested by:	Joshua Martin, Deputy Director, Office of Facilities Management, Massachusetts DOR
Reason for Request:	Lease renewal indoor air quality (IAQ) status report
Date of Assessment:	November 15, 2016
Massachusetts Department of Public Health/Bureau of Environmental Health (MDPH/BEH) Staff Conducting Assessment:	Ruth Alfasso, Environmental Engineer/Inspector, IAQ Program
Building Description:	These offices are located in the Worcester Business Center, a five-story office building that was originally constructed as a mill in 1917, repurposed as the headquarters for a shoe-manufactory in 1965, and remodeled into general office space in 2008.
Building Population:	Approximately 130 employees in three suites on the third floor.
Windows:	Not openable

Methods

Please refer to the IAQ Manual for methods, sampling procedures, and interpretation of results (MDPH, 2015).

IAQ Testing Results

The following is a summary of indoor air testing results (Table 1).

- ***Carbon dioxide levels*** were below 800 parts per million (ppm) in all areas assessed, indicating adequate fresh air in the space.
- ***Temperature*** was within the recommended range of 70°F to 78°F in all areas assessed.

- ***Relative humidity*** was below the recommended range of 40% to 60% in all areas assessed.
- ***Carbon monoxide*** levels were non-detectable in all indoor areas assessed.
- ***Fine particulate matter (PM2.5)*** concentrations measured were below the National Ambient Air Quality Standard (NAAQS) level of 35 $\mu g/m^3$ in all areas assessed.

Ventilation

A heating, ventilating, and air conditioning (HVAC) system has several functions. First, it provides heating and, if equipped, cooling. Second, it is a source of fresh air. Finally, an HVAC system will dilute and remove normally occurring indoor environmental pollutants by not only introducing fresh air, but also filtering the airstream and ejecting stale air to the outdoors via exhaust ventilation. Even if an HVAC system is operating as designed, point sources of respiratory irritation may exist and affect symptoms in sensitive individuals. The following analysis examines and identifies components of the HVAC system and likely sources of respiratory irritant/allergen exposure due to water damage, aerosolized dust, and/or chemicals found in the indoor environment.

Fresh air is provided by air handling units (AHUs). Air from the AHUs is filtered, heated/cooled, and delivered to rooms via ducted supply vents (Picture 1). Air is returned/exhausted through vents in the walls or ceiling (Pictures 2 and 3).

The assessment results indicate that the ventilation system is providing adequate fresh air for the occupancy in the building. In some areas assessed, the thermostats were observed to be set to the “fan auto” setting, which does not provide a continuous source of fresh air; the “fan on” setting is preferred in occupied areas.

In the conference room, carbon dioxide sensors were located next to the thermostats to direct the ventilation system to provide more fresh air during periods of high occupancy. These should be calibrated or replaced in accordance with manufacturer’s recommendations.

In one of the unoccupied sections, the supply vent velocity was high enough to blow the blinds around which may be uncomfortable if/when the area is occupied again. It is recommended that HVAC systems be re-balanced every five years to ensure adequate air systems function (SMACNA, 1994).

Microbial/Moisture Concerns

Plants were observed in office areas (Table 1; Pictures 4 and 5). Plants can be a source of pollen and mold, which can be respiratory irritants to some individuals. Plants should be properly maintained and equipped with drip pans to prevent water damage to porous materials. Plants should also be located away from air diffusers to prevent the aerosolization of dirt, pollen, and mold.

Small refrigerators and water dispensers were observed in carpeted areas (Pictures 6 and 7). These appliances may spill or leak and lead to carpet damage and microbial growth; Picture 7 shows stained carpeting next to a refrigerator. It is recommended that these appliances be located in areas without carpeting or on waterproof mats. Carpet squares could also be replaced with tile in areas where water dispensers and refrigerators are located. Some of the refrigerators were crowded with items or had evidence of spills (Picture 8). Refrigerators should be kept clean to prevent odors and microbial growth.

A ductless air conditioning unit was observed in the computer training room (Picture 9). The condensate pump and piping that connect this unit with a drain should be inspected periodically for clogs and leaks to prevent water damage to nearby building materials.

Other IAQ Evaluations

Exposure to low levels of total volatile organic compounds (TVOCs) may produce eye, nose, throat, and/or respiratory irritation in some sensitive individuals. To determine if VOCs were present, BEH/IAQ staff examined rooms for products containing VOCs. BEH/IAQ staff noted hand sanitizers, cleaners, scented candles, and dry erase materials in use within the building (Pictures 10 and 11; Table 1). All of these products have the potential to be irritants to the eyes, nose, throat, and respiratory system of sensitive individuals.

Peeling paint was observed on ceiling beams in a few areas (Picture 12). This can create irritating dust and it is unknown if the paint may contain lead.

Cooking equipment, including toasters, microwave ovens and coffee machines were located in various parts of the office space (Picture 13). The presence of so many different pieces of cooking equipment near workstations and without direct exhaust ventilation increases the chance of food odors permeating office areas. Food areas and cooking equipment need to be kept clean to prevent odors and pests. Carpeting in these areas may trap crumbs and spills as well.

Consider consolidating cooking areas into unoccupied and uncarpeted areas or protect the carpeting in these areas with a mat.

The offices were mostly carpeted. Carpets should be cleaned annually (or semi-annually in soiled/high traffic areas) in accordance with Institute of Inspection, Cleaning and Restoration Certification (IICRC) recommendations, (IICRC, 2012).

In some areas, stored materials and accumulated items make it more difficult for custodial staff to clean. Items should be stored neatly and moved periodically to allow for wet wiping and vacuuming of surfaces

Personal fans were observed in a number of areas. Fan blades to some of these units had settled dust, which can be reaerosolized when the fan is activated. Some supply and exhaust vents were also dusty (e.g., Picture 3). It was reported that cleaning of carpeting and vents was scheduled for shortly after this visit.

Conclusions/Recommendations

Based on observations at the time of assessment, the following is recommended:

1. Operate supply and exhaust ventilation in all areas during occupied periods.
2. Have the carbon dioxide sensors in conference rooms recalibrated or replaced in accordance with manufacturer's recommendations.
3. Check the supply vent velocity in unoccupied areas before they are to be occupied.
4. Have the HVAC system balanced every 5 years in accordance with SMACNA recommendations (SMACNA, 1994).
5. Keep indoor plants in good condition, avoid overwatering, and avoid placing them on porous items such as carpets or paper. Also, keep plants out of the air stream of supply vents.
6. Consider locating refrigerators and water dispensers in non-carpeted areas or place on a waterproof mat.
7. Clean refrigerator spills promptly and clean refrigerators out regularly to avoid odors and microbial growth.
8. Inspect condensate pumps and piping for ductless air-conditioning units regularly.
9. Have the peeling paint on the ceiling beams repaired.

10. Ensure cooking areas/equipment are kept clean to prevent odors and pests. Consider reducing the number of areas where food is stored and locating them away from occupied areas.
11. For buildings in New England, periods of low relative humidity during the winter are often unavoidable. Therefore, scrupulous cleaning practices should be adopted to minimize common indoor air contaminants whose irritant effects can be enhanced when the relative humidity is low. To control for dusts, a high efficiency particulate arrestance (HEPA) filter equipped vacuum cleaner in conjunction with wet wiping of all surfaces is recommended. Avoid the use of feather dusters. Drinking water during the day can help ease some symptoms associated with a dry environment (throat and sinus irritations).
12. Change filters on AHUs on a regular schedule at least twice a year.
13. Clean carpeting in accordance with IICRC recommendations (IICRC, 2012).
14. Reduce accumulated materials on flat surfaces and store in an organized manner to allow for thorough cleaning.
15. Clean the blades of personal fans, supply, and exhaust vents periodically to avoid aerosolizing dusts.
16. Refer to resource manual and other related IAQ documents located on the MDPH's website for further building-wide evaluations and advice on maintaining public buildings. These documents are available at: http://mass.gov/dph/iaq.

References

IICRC. 2012. Institute of Inspection, Cleaning and Restoration Certification. Carpet Cleaning: FAQ. Retrieved from http://www.iicrc.org/consumers/care/carpet-cleaning.

MDPH. 2015. Massachusetts Department of Public Health. Indoor Air Quality Manual: Chapters I-III. Available at: http://www.mass.gov/eohhs/gov/departments/dph/programs/environmental-health/exposure-topics/iaq/iaq-manual/.

SMACNA. 1994. HVAC Systems Commissioning Manual. 1st ed. Sheet Metal and Air Conditioning Contractors' National Association, Inc., Chantilly, VA.

Picture 1

Supply vent

Picture 2

Wall-mounted exhaust vents in Local Services suite

Picture 3

Ceiling-mounted exhaust vent in Child Support suite, note dust

Picture 4

Plant overhanging cloth divider

Picture 5

Plants in a cubicle

Picture 6

Water dispenser on carpet

Picture 7

Refrigerator and water dispenser next to stained carpeting

Picture 8

Refrigerator with evidence of spill on bottom shelf

Picture 9

Ductless air-conditioning unit in computer training room

Picture 10

Cleaning product in an office

Picture 11

Scented candle

Picture 12

Peeling paint on a ceiling beam

Picture 13

Coffee station and microwave oven

Location: Department of Revenue Office **Indoor Air Results**

Address: 67 Millbrook Street #300, Worcester, MA **Table 1** **Date: 11/15/2016**

Location	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	Temp (°F)	Relative Humidity (%)	PM2.5 ($\mu g/m^3$)	Occupants in Room	Windows Openable	Ventilation		Remarks
								Supply	Exhaust	
Background	371	0.7	55	32	17					Cool, cloudy
Local services										
Waiting	545	ND	71	25	10	1	N	Y	Y	PF, HS
Kitchen area/storage	516	ND	72	24	9	0	N	N	Y	DO, PF, NC, fridge and microwave, fridge with spill inside
Office	564	ND	72	24	9	0	N	Y	Y	Peeling paint from ceiling beam, stand fan
Creen (cubes)	530	ND	73	24	10	1	N	Y	Y	WC on carpet, peeling paint on ceiling beam, paper on windowsill
Silvia (cubes)	518	ND	73	23	9	0	N	Y	Y	Items on windowsill
Morgan (cubes)	505	ND	73	23	9	0	N	Y	Y	
Bliss (office)	529	ND	73	23	9	0	N	N	Y	DO
Photocopier area	505	ND	73	22	10	0	N	Y	Y	PC and printer

ppm = parts per million
$\mu g/m^3$ = micrograms per cubic meter
ND = non detect
AC = air-conditioner
AI = accumulated items
CP = cleaning products
PF = personal fan
DEM = dry erase materials
DO = door open
HS = hand sanitizer
NC = not carpeted
WC = water cooler
WD = water-damaged

Comfort Guidelines

Carbon Dioxide: < 800 ppm = preferred
> 800 ppm = indicative of ventilation problems

Temperature: 70 - 78 °F
Relative Humidity: 40 - 60%

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Location	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	Temp (°F)	Relative Humidity (%)	PM2.5 ($\mu g/m^3$)	Occupants in Room	Windows Openable	Ventilation		Remarks
								Supply	Exhaust	
Paquette (cubes)	517	ND	73	23	9	3	N	Y	Y	
Tax Offices										
Waiting	527	ND	74	21	8	0	N	Y	Y	
Vacant suite, area 1 (cubes)	454	ND	73	20	10	0	N	Y	Y	Peeling paint on ceiling beams, WD windowsill, stand fan
Vacation suite, area 2 (cubes)	481	ND	73	21	10	0	N	Y	Y	Water cooler on carpet
Casper (cubes)	465	ND	73	21	10	0	N	Y	Y	
Donahue (cubes)	453	ND	73	21	10	0	N	Y	Y	HS, PF
Small conference room	499	ND	73	21	9	0	N	Y	Y	
Pignatio (cubes)	505	ND	73	22	9	3	N	Y	Y	PF, fridge on carpet
Adamek (cubes)	527	ND	73	22	9	0	N	Y	Y	Plants

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								Supply	Exhaust	
Chamboleir (cubes)	507	ND	73	21	9	1	N	Y	Y	Many plants, fridge on carpet
Berthiaume (cubes)	552	ND	73	22	9	1	N	Y	Y	PF, CP, food, fridge on carpet
Bartziewcz (cubes)	573	ND	73	21	8	0	N	Y	Y	
Masiello (cubes)	606	ND	73	22	13	1	N	Y	Y	
Rota (cubes)	605	ND	73	22	7	1	N	Y	Y	
Epstein (cubes)	531	ND	73	21	9	0	N	Y	Y	
McAuliffe (cubes)	535	ND	73	21	9	0	N	Y	Y	
Teilor (cubes)	535	ND	74	21	8	1	N	Y	Y	
Pollard (cubes)	569	ND	74	22	9	3	N	Y	Y	Fridge on carpet, fridge needs cleaning
Cavelle (cubes)	479	ND	74	20	7	0	N	Y	Y	

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Conference	477	ND	73	20	7	0	N	Y	Y	
Office	496	ND	73	21	7	3	N	Y	N	DO, wrinkled carpet
Child Support office										
Empty cube area 1	463	ND	73	21	11	0	N	Y	Y	Vent against windows on very high velocity
Empty cube area 2	432	ND	71	20	7	0	N	Y	Y	
Big conference room	540	ND	72	22	11	0	N	Y	Y	Carbon dioxide monitor
Computer training	495	ND	73	21	2	0	N	Y	Y	Ductless AC unit, ajar tile, DEM, 15 computers
Office next to computer training	475	ND	72	21	11	0	N	Y	Y	DO
Arguijo (cubes)	516	ND	71	21	10	1	N	Y	Y	Plants
Interview A	553	ND	72	21	10	0	N	N	N	HS

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Interview B	471	ND	71	21	11	0	N	Y	N	HS
Snyder	468	ND	71	21	10	0	N	Y	Y	Items, stained carpet, water cooler on carpet
Reception (inside)	550	ND	72	21	10	2	N	Y	Y	
Procipio	490	ND	72	21	10	1	N	Y	Y	Mechanical room next to this area, door ajar and vent (return). Fridge and microwave
Waiting room	544	ND	73	21	11	1	N	Y	Y	Elevator area
Office	493	ND	73	21	12	0	N	Y	Y	Fridge and microwave
Piclett (cubes)	560	ND	73	22	10	1	N	Y	Y	AI/paper on floor, fridge on carpet
Dirlinge (cubes)	664	ND	73	23	9	1	N	Y	Y	DO, plants, coffee
Ruggieri (cubes)	701	ND	74	22	9	1	N	Y	Y	

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Brent (office)	680	ND	74	22	10	1	N	Y	Y	Plants, CP
Quinn (office)	716	ND	74	22	9	1	N	Y	Y	Items on windowsill, scented candle
Eaton (cubes)	657	ND	74	21	9	0	N	Y	Y	DEM, food, plant
McCann (cubes)	652	ND	74	21	9	2	N	Y	Y	Plant
Hughes (cubes)	638	ND	75	21	9	3	N	Y	Y	Items on walls, DEM
Colon (cubes)	622	ND	75	21	9	3	N	Y	Y	Plants
Maher (cubes)	601	ND	74	20	9	1	N	Y	Y	Plants
Anderson (cubes)	601	ND	75	21	9	1	N	Y	Y	Plants
Corbett (cubes)	604	ND	74	20	8	1	N	Y	Y	
McDonald (cubes)	564	ND	74	20	8	0	N	Y	Y	Fan “auto”

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Matthews (cubes)	610	ND	74	21	9	0	N	Y	Y	Many plants
Burns (cubes)	601	ND	74	21	8	1	N	Y	Y	Plants, coffee
Whitney (cubes)	621	ND	74	21	9	1	N	Y	Y	
Stonette (cubes)	626	ND	74	21	9	0	N	Y	Y	Storage

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